CLAIMS:

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent is:

1. A wavelength-locked loop servo-control circuit that enables real time mutual alignment of an electromagnetic signal having a peaked spectrum function including a center wavelength and a wavelength selective device implementing a peaked passband function including a center wavelength, in a system employing electromagnetic waves, said circuit comprising:

mechanism for applying a dither modulation signal at a dither modulation frequency to said electromagnetic signal, and inputting said dither modulated electromagnetic signal to said wavelength selective device;

mechanism for converting a portion of said dither modulated electromagnetic signal to an electric feedback signal;

mechanism for continuously comparing said feedback signal with said dither modulation signal and generating an error signal representing a difference between a frequency characteristic of said feedback signal and a dither modulation frequency; and

mechanism for adjusting the peak spectrum function of said electromagnetic signal according to said error signal, wherein said center wavelength of said electromagnetic signal and said wavelength selective device center wavelength become aligned when said frequency characteristic of said feedback signal is two times said dither modulation frequency.

2. The wavelength-locked loop servo-control circuit as claimed in Claim 1, wherein said electromagnetic waves include those waves at frequencies selected from the group consisting of: radio frequency, microwave frequency and optical frequency portions of an electromagnetic frequency spectrum, said electromagnetic signal comprising one of: a radio frequency signal, microwave signal, and optical signal, respectively.

3. The wavelength-locked loop servo-control circuit as claimed in Claim 2, wherein said optical signal comprises a laser signal employed in an optical network, said optical network including:

a laser diode device for generating said laser signal; and,

a laser bias voltage control circuit for providing a bias voltage to a laser diode device for controlling said laser signal, wherein said mechanism for adjusting said optical signal includes applying said error signal to said laser bias control circuit for adjusting a center wavelength characteristic of said laser signal.

4. The wavelength-locked loop servo-control circuit as claimed in Claim 2, wherein said electromagnetic signal is employed in an information carrying system employing microwaves, said information carrying system including:

a microwave generator device for generating said microwave signal; and,

a driver control circuit for providing a drive signal to said microwave generator device for controlling said microwave signal, wherein said mechanism for adjusting said microwave signal includes applying said error signal to said driver control circuit for adjusting a center wavelength characteristic of said microwave signal.

5. The wavelength-locked loop servo-control circuit as claimed in Claim 1, wherein said wavelength selective device includes a bandpass filter having a desired wavelength representing a filter passband center wavelength, wherein said electromagnetic signal is tuned to said passband center wavelength so that signal power is maximally transmitted through said bandpass filter in said system.

6. The wavelength-locked loop servo-control circuit as claimed in Claim 1, wherein said wavelength selective device comprises multiple bandpass filters in series, said multiple bandpass filters exhibiting a composite filter response representing a passband center wavelength, wherein said electromagnetic signal is tuned to said passband center wavelength so that signal power is maximally transmitted through said series of multiple bandpass filters in said system.

7. The wavelength-locked loop servo-control circuit as claimed in Claim 1, wherein said device for applying a dither modulation to said bias signal is a sinusoidal dither circuit for generating a sinusoidal dither modulation signal of a predetermined frequency.

8. The wavelength-locked loop servo-control circuit as claimed in Claim 2, wherein said converting mechanism includes one selected from the group of: a radio frequency detector, a microwave detector, and an optical signal detector device.

9. The wavelength-locked loop servo-control circuit as claimed in Claim 8, wherein said optical signal detector includes a photodetector.

10. The wavelength-locked loop servo-control circuit as claimed in Claim 8, wherein said microwave signal detector includes a surface acoustic wave detector.

11. The wavelength-locked loop servo-control circuit as claimed in Claim 7, wherein said device for comparing includes a mixer capable of combining said converted feedback

signal with said sinusoidal dither modulation signal and generating a cross-product signal having components representing a sum and difference at dither frequencies.

12. The wavelength-locked loop servo-control circuit as claimed in Claim 11, further including:

low-pass filter device for filtering said output cross-product signal; and

integrator circuit for averaging said output cross-product signal to generate said error signal, whereby said error signal is positive or negative depending on whether a center wavelength of said electromagnetic signal is respectively less than or greater than said desired wavelength of said wavelength selective device.

13. The wavelength-locked loop servo-control circuit as claimed in Claim 1, further including wavelength shifter device for receiving said error signal and varying said error signal in an amount to offset the electromagnetic signal center wavelength in a predetermined manner.

14. The wavelength-locked loop servo-control circuit as claimed in Claim 3, further including thermocouple device for receiving said error signal and modifying a temperature of said laser diode for adjusting a frequency of said laser signal in an appropriate direction according to said error signal.

15. The wavelength-locked loop servo-control circuit as claimed in Claim 3, wherein said wavelength selective device includes an optical amplifier.

16. The wavelength-locked loop servo-control circuit as claimed in Claim 3, wherein said wavelength selective device includes an optical attenuator.

17. The wavelength-locked loop servo-control circuit as claimed in Claim 3, wherein said wavelength selective device includes an optical switch.

18. A wavelength-locked loop servo-control circuit that enables real time mutual alignment of an electromagnetic signal having a peaked spectrum function including a center wavelength and a tunable wavelength selective device implementing a peaked passband function including a center wavelength, in a system employing electromagnetic waves, said circuit comprising:

mechanism for applying a dither modulation signal at a dither modulation frequency to said tunable wavelength selective device, said tunable wavelength selective device further receiving an electromagnetic signal having a center wavelength and generating a dither modulated optical signal for output thereof;

mechanism for converting a portion of said dither modulated electromagnetic signal to an electric feedback signal;

mechanism for continuously comparing said feedback signal with said dither modulation signal and generating an error signal representing a difference between a frequency characteristic of said feedback signal and a dither modulation frequency; and

mechanism for adjusting a passband center wavelength of said tunable wavelength selective device according to said error signal, wherein said center wavelength of said electromagnetic signal and said tunable wavelength selective device center wavelength become aligned when said frequency characteristic of said feedback signal is two times said dither modulation frequency.

19. The wavelength-locked loop servo-control circuit as claimed in Claim 18, wherein said electromagnetic signal is a laser signal exhibiting a peaked spectrum function having a center wavelength.

20. The wavelength-locked loop servo-control circuit as claimed in Claim 19, wherein said tunable wavelength selective device includes a bandpass filter having a tunable passband center wavelength, wherein said tunable passband center wavelength is tuned to a center wavelength of said laser signal so that optical signal power is maximally transmitted through said bandpass filter.

21. A method for mutually aligning a center wavelength of an electromagnetic signal of having a peaked spectrum function with a center wavelength of a wavelength selective device implementing a peaked passband function, in a system employing electromagnetic waves, said method comprising the steps of:

a) applying a dither modulation signal at a dither modulation frequency to said electromagnetic signal operating at a specific wavelength, and inputting said dither modulated electromagnetic signal to said wavelength selective device having a peak frequency response at a desired wavelength;

b) converting a portion of said dither modulated electromagnetic signal to an electric feedback signal;

c) continuously comparing said feedback signal with said dither modulation signal and generating an error signal representing a difference between a frequency characteristic of said feedback signal and a dither modulation frequency; and

d) adjusting the peak spectrum function of said electromagnetic signal according to said error signal, wherein said center wavelength of said electromagnetic signal and said

wavelength selective device center wavelength become aligned when said frequency characteristic of said feedback signal is two times said dither modulation frequency.

22. The method as claimed in Claim 21, wherein said electromagnetic signal is a laser signal having a center wavelength, said optical network including a laser diode device for generating said laser signal and, a laser bias voltage control circuit for providing a bias voltage to a laser diode device for controlling said laser signal, wherein said adjusting step d) includes applying said error signal to said laser bias control circuit for adjusting a center wavelength characteristic of said laser signal.

23. The method as claimed in Claim 21, wherein said wavelength selective device includes a bandpass filter having a desired wavelength representing a filter passband center wavelength, said method including tuning said electromagnetic signal to said passband center wavelength so that electromagnetic signal power is maximally transmitted through said bandpass filter in said system.

24. The method as claimed in Claim 21, wherein said wavelength selective device comprises multiple bandpass filters in series, said multiple bandpass filters exhibiting a composite filter response representing a passband center wavelength, said method including tuning said optical signal to said passband center wavelength so that optical signal power is maximally transmitted through said series of multiple bandpass filters in said optical system.

25. The method as claimed in Claim 21, wherein said continuously comparing step c) includes the steps of:

combining said converted feedback signal with said dither modulation signal and generating a cross-product signal having components representing a sum and difference at dither frequencies.

filtering said output cross-product signal; and

averaging said output cross-product signal to generate said error signal, said error signal being positive or negative depending on whether a center wavelength of said electromagnetic signal is respectively less than or greater than said desired wavelength of said wavelength selective device.

26. The method as claimed in Claim 21, wherein said adjusting step e) includes the step of: receiving said error signal and varying said error signal in an amount to offset the electromagnetic signal center wavelength in a predetermined manner.

27. The method as claimed in Claim 22, wherein said step of modifying the bias signal includes the step of providing a thermocouple device for receiving said error signal and modifying a temperature of said laser diode for adjusting a frequency of said laser signal in an appropriate direction according to said error signal.

28. A method for mutually aligning a center wavelength of an electromagnetic signal of having a peaked spectrum function with a center wavelength of a wavelength selective device implementing a peaked passband function, in a system employing electromagnetic waves, said method comprising the steps of:

a) applying a dither modulation signal at a dither modulation frequency to said tunable wavelength selective device, said tunable wavelength selective device further receiving an electromagnetic signal having a center wavelength and generating a dither modulated electromagnetic signal for output thereof;

b) converting a portion of said dither modulated electromagnetic signal to an electric feedback signal;

c) continuously comparing said feedback signal with said dither modulation signal and generating an error signal representing a difference between a frequency characteristic of said feedback signal and a dither modulation frequency; and

d) adjusting a passband center wavelength of said tunable wavelength selective device according to said error signal, wherein said center wavelength of said electromagnetic signal and said tunable wavelength selective device center wavelength become aligned when said frequency characteristic of said feedback signal is two times said dither modulation frequency.

29. The method as claimed in Claim 28, wherein said tunable wavelength selective device includes a bandpass filter having a tunable passband center wavelength, wherein said tunable passband center wavelength is tuned to a center wavelength of said electromagnetic signal so that electromagnetic signal power is maximally transmitted through said bandpass filter in said system.

30. A servo-control circuit for tuning a laser signal generator providing an optical signal at a specified wavelength in an optical system, said optical system including a bandpass filter device for receiving and transmitting optical signals in said optical system at a desired wavelength, said servo-control system comprising:

device for applying a bias signal to said laser signal generator for tuning said optical signal to a specific wavelength;

device for applying a dither modulation to said bias signal to produce a dither modulated optical signal, said dither modulated optic signal being input to said bandpass filter device;

detector device for receiving said dither modulated optical signal output from said bandpass filter device and converting said received optical signal into an electrical feedback signal; and,

device for continuously comparing frequency characteristics of said converted feedback signal against frequency characteristic of a dither modulation signal and generating an error signal therefore, said error signal responsively modifying the bias signal until a predetermined relation exists between a frequency characteristic of said converted feedback signal and a dither modulation frequency, whereby when said predetermined relation exists, said wavelength of said optical signal exactly matches the desired wavelength of said wavelength selective device.

31. The servo-control circuit for tuning a laser signal generator as claimed in Claim 30, wherein said predetermined relation exists when a frequency of said feedback signal is two times a dither modulation frequency.

32. The servo-control circuit for tuning a laser signal generator as claimed in Claim 30, wherein said bandpass filter device comprises multiple bandpass filters in series, said multiple bandpass filters exhibiting a composite filter response representing a passband center wavelength, wherein said laser signal is tuned to said passband center wavelength so that optical signal power is maximally transmitted through said series of multiple bandpass filters in said optical system.

33. The servo-control circuit for tuning a laser signal generator as claimed in Claim 30, wherein said detector includes a photodetector device.

34. The servo-control circuit for tuning a laser signal generator as claimed in Claim 33, wherein said photodetector device is a p-i-n diode.

35. The servo-control circuit for tuning a laser signal generator as claimed in Claim 30, wherein said device for comparing includes:

a mixer capable of combining said converted feedback signal with said dither modulation signal and generating a cross-product signal having components representing a sum and difference at dither frequencies;

a low-pass filter device for filtering said output cross-product signal; and

an integrator circuit for averaging said output cross-product signal to generate said error signal, whereby said error signal is positive or negative depending on whether a center wavelength of said optical signal is respectively less than or greater than said desired wavelength of said wavelength selective device.

36. The servo-control circuit for tuning a laser signal generator as claimed in Claim 30, further including wavelength shifter device for receiving said error signal and varying said error signal in an amount to accordingly adjust said bias signal applied to said laser diode to offset the laser signal center wavelength in a predetermined manner.

37. The servo-control circuit for tuning a laser signal generator as claimed in Claim 30, further including thermocouple device for receiving said error signal and modifying a temperature of said laser diode for adjusting a frequency of said laser signal in an appropriate direction according to said error signal.

38. A servo-control circuit for tuning a tunable wavelength selective device capable of receiving and transmitting optical signals of a desired wavelength in an optical system, said servo-control system comprising:

mechanism for applying a dither modulation signal at a dither modulation frequency to said tunable wavelength selective device, said tunable wavelength selective device further receiving said optical signal having a center wavelength and generating a dither modulated optical signal for output thereof;

mechanism for converting a portion of said dither modulated optical signal to an electric feedback signal;

mechanism for continuously comparing said feedback signal with said dither modulation signal and generating an error signal representing a difference between a frequency characteristic of said feedback signal and a dither modulation frequency; and

mechanism for adjusting a passband center wavelength of said tunable wavelength selective device according to said error signal until a predetermined relation exists between a frequency characteristic of said converted feedback signal and said dither modulation frequency, whereby when said predetermined relation exists, said desired wavelength of said wavelength selective device exactly matches a wavelength of said input optical signal.

39. The servo-control circuit for tuning a tunable wavelength selective device as claimed in Claim 38, wherein said predetermined relation exists when a frequency of said feedback signal is two times a dither modulation frequency.

40. A method for tuning a laser signal generator providing an optical signal at a specified wavelength in an optical system, said optical system including a bandpass filter device for receiving and transmitting optical signals in said optical system at a desired wavelength, said method comprising the steps of:

a) applying a bias signal to said laser signal generator for tuning said optical signal to a specific wavelength;

b) applying a dither modulation to said bias signal to produce a dither modulated optical signal, said dither modulated optic signal being input to said bandpass filter device;

c) converting said received optical signal into an electrical feedback signal; and,

d) continuously comparing frequency characteristics of said converted feedback signal against a frequency characteristic of a dither modulation signal and generating an error signal therefore, said error signal responsively modifying the bias signal until a predetermined relation exists between a frequency characteristic of said converted feedback signal and dither modulation frequency, whereby when said predetermined relation exists, said wavelength of said optical signal exactly matches the desired wavelength of said wavelength selective device.

41. The method for tuning a laser signal generator as claimed in Claim 40, wherein said predetermined relation exists when a frequency of said feedback signal is two times a dither modulation frequency.

42. The method for tuning a laser signal generator as claimed in Claim 40, wherein said continuously comparing step d) includes the steps of:

combining said converted feedback signal with said dither modulation signal and generating a cross-product signal having components representing a sum and difference at dither frequencies.

filtering said output cross-product signal; and

averaging said output cross-product signal to generate said error signal, said error signal being positive or negative depending on whether a center wavelength of said optical signal is respectively less than or greater than said desired wavelength of said wavelength selective device.

43. The method for tuning a laser signal generator as claimed in Claim 40, further including the step of: providing wavelength shifter device for receiving said error signal and varying said error signal in an amount to accordingly adjust said bias signal applied to said laser diode to offset the laser signal center wavelength in a predetermined manner.

44. The method for tuning a laser signal generator as claimed in Claim 40, further including the step of: providing thermocouple device for receiving said error signal and modifying a temperature of said laser diode for adjusting a frequency of said laser signal in an appropriate direction according to said error signal.